stances, the liquefying agent would be free to act. So far as we know no experiments of this sort have ever been performed, though it may be significant that Setchell failed to find any algæ growing at 43°–45° C.

In a recent paper Osterhout[20] advances the hypothesis that substances which increase permeability antagonize those which decrease permeability. He says (p. 256):

> It seems to the writer that the hypothesis offers a rational explanation of antagonism by showing that salts antagonize each other because they produce opposite effects upon the protoplasm.

The nature of these "opposite effects upon the protoplasm" is an increase or decrease of permeability. Osterhout makes no statement as to the meaning of the term "permeability" which, without further qualification, is noncommittal, nor to the *cause* of the permeability changes. With these two fundamental gaps in the theory it seems a far cry to a "rational explanation of antagonism." We have emphasized above that a study of Osterhout's data indicates a direct correlation between decreased permeability and increased surface viscosity. It seems highly probable, however, that all substances producing an initial decrease in permeability will, if allowed to act long enough or in sufficient concentration eventually cause an *increase* in permeability.[21] This conclusion, which we are forced to make from a study of the phenomena of viscosity changes in colloids, complies very well with the experimental data upon permeability changes in both plant and animal cells.

All physical and chemical agents acting upon a colloidal system influence the state of aggregation of the disperse phase, tending either to increase or to decrease the degree of dispersion. Since we have a colloidal system at the surface of every cell, all physical and chemical agents influence the state of aggregation or its equivalent, the solubility of the surface disperse phases in one of two ways, viz., (1) there may be an increase in the degree of dispersion and a corresponding increase in the solubility of the disperse phases and the fluidity of the cell surface, or (2) there may be a decrease in the degree of dispersion or a decreased solubility of the disperse phases which eventually results in a precipitation or coagulation. An "antagonism" is to be considered a physiological compensation of a force favoring dispersion (solubility) by a second force favoring aggregation (insolubility). This relation is reciprocal.

[20] Osterhout, *loc. cit.*

[21] Osterhout calls attention to this fact, but offers no explanation for it.

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SPECIAL ARTICLES

NATURAL CROSS-POLLINATION IN THE TOMATO

EVIDENCE concerning the amount of natural cross-pollination in the tomato has been secured by interplanting two commercial varieties of tomatoes, one a standard and the other a dwarf variety. The difference in habit of growth between these varieties is quite distinct in the early seedling stage. The standard is almost completely dominant over the dwarf type of growth. Any pollen from a standard plant fertilizing a dwarf plant should result in a standard plant in the first generation. To test this point a number of dwarf and standard plants were set three feet apart alternately. They were at least five hundred yards removed from any other dwarf tomatoes. These plants were allowed to set fruit normally and seed was saved from the dwarf plants as the fruit ripened. The dates on which the ripe fruit was gathered correspond approximately to the order in which the flowers were fertilized. Seed from these "open-pollinated" dwarf plants was planted in flats in the greenhouse. The number of standard plants which could be plainly distinguished after six weeks' growth was determined and tabulated.

The approximately two per cent. of crossed plants does not represent all the crossing which might have taken place. Aside from a slightly greater distance, there was an equal chance for the dwarf plants to be fertilized by pollen from other dwarf plants. This crossing would produce only dwarf plants, and hence would not show.

THE NUMBER OF STANDARD PLANTS PRODUCED FROM SEED OF OPEN-POLLINATED DWARF PLANTS

Date Ripe Fruit Gathered	Number of Plants Grown	Number of Standard Plants	Number of Dwarf Plants	Per Cent. of Standard Plants
August 10	935	28	907	2.99
" 21	61	0	61	0.00
" 27	128	1	127	0.78
September 4...	51	1	50	1.96
" 22...	995	13	982	1.31
Total	2,170	43	2,127	1.98

Whether or not cross-pollination is caused by wind or insects is not known, although no large insects, such as bees, were seen to visit the plants. Moreover, tomato pollen is dry and seems better adapted to wind transportation. This could be easily tested by screening the dwarf plants. This would not preclude the possibility of cross-pollination by thrips.

Flowers which are bagged in the bud stage and left undisturbed usually do not set fruit. Jarring the plant while the anthers are dehiscing generally suffices to cause pollination. Tomatoes in greenhouses do not set fruit well unless artificially pollinated.

It seems from this evidence that the tomato is naturally only slightly cross-fertilized. Some external agency, however, is generally needed for self-pollination as well as for cross-pollination.

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SOCIETIES AND ACADEMIES

THE AMERICAN PHILOSOPHICAL SOCIETY

AT the January meeting of the society held January 7, Professor J. A. Miller, of Swarthmore College, read a paper on "The Determination of the Distances of Stars from Us."

He sketched the attempts of Copernicus, Tycho, Braché, Bradley and Sir William Herschel to find a sensible stellar parallax. Perhaps the chief reason for desiring a stellar parallax at that time was that it would establish the truth of the Copernican system upon observational rather than theoretical evidence.

Although these men failed in their attempts to determine a parallax it was while making observations for that that Bradley discovered the aberration of light and Herschel established the fact that a physical connection exists between the components of certain double stars.

It was 300 years after Copernicus, more than a century after Bradley and a half century after Herschel before the first sensible parallax of a star was actually found when Bessell found the parallax of 61 Cygni and Henderson a parallax of α Centauri. Bessell completed his observations in 1840 and although astronomers have been working assiduously ever since, reliable parallaxes of only about 400 stars have been determined.

At present eight American observatories are working at the problem under the direction of a committee appointed by the American Astronomical Society. Most of these observatories are applying the photographic method devised by Pritchard, of Oxford. This method has since been refined and improved by various men, most notably perhaps by Schlesinger.

The Sproul Observatory of Swarthmore College is one of the eight observatories mentioned above and is spending most of the energies of its staff in that direction. They have determined in all 46 parallaxes. The program contains:

1. All visual binaries whose orbits are well determined.
2. Those visual binaries, the data concerning which leads us to believe their orbits will be determined in the not very distant future.
3. Some spectroscopic binaries.
4. Some stars of large proper motion.
5. Some stars whose hypothetical parallax is large.
6. Other objects.

Classes 1, 2, 3, receive most attention and the measurements and reductions of 13 stars of Class 1 have been completed.

Though no generalization could be made from so small a number of stars as this, yet so far as can be judged from these 13 stars, the orbits of the binaries are comparable in magnitude to the orbits of the planets. The greatest distance between two components of any double star in this list (τ Cygni) being 32 astronomical units, and the least being four astronomical units for 85 Pegasi.

The combined masses of the two components average larger than the sun. The largest mass being of Lalande 9091, which is 48 times the sun and the smallest being 20 Persei which is 0.26 that of the sun.